Citation:

Djoussé L, Rudich T, Gaziano JM. Nut consumption and risk of hypertension in US male physicians. *Clin Nutr.* 2009 Feb;28(1):10-4.

PubMed ID: 18834651

Study Design:

Prospective Cohort Study

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the association between nut consumption and lower risk of incident hypertension.

Inclusion Criteria:

Participants in the Physician's Health Study (PHS) I - a completed randomized, double-blind, placebo-controlled trial designed to study low-dose aspirin and beta-carotene for the primary prevention of cardiovascular disease and cancer.

Exclusion Criteria:

Subjects with missing data on nut consumption, prevalent hypertension at the time of exposure assessment, and missing covariates.

Description of Study Protocol:

Recruitment: In 1981, the PHS team sent out invitation letters, consent forms, and enrollment questionnaires to all 261,248 male physicians between 40 and 84 years of age who lived in the United States and who were registered with the American Medical Association. Almost half responded to the invitation.

For the present study, subjects were already recruited and data collected from the PHS study.

Design: Prospective cohort study

Blinding used: not applicable

Intervention: not applicable

Statistical Analysis:

- *p* value for linear trend was used for baseline characteristics
- Logistic regression was used for categorical variables
- Linear regression was used for continuous variables
- Cox proportional hazard model was used to compute multivariable adjusted hazard ratios with corresponding 95% confidence intervals using subjects in the lowest category of nut consumption as the reference group.

Data Collection Summary:

Timing of Measurements:

Demographic data were collected at baseline. Data on selected foods such as fruits and vegetables, breakfast cereal with brand, physical activity, smoking, alcohol consumption, liver intake, low fat and whole milk and history of hypercholesterolemia or treatment for hypercholesterolemia were obtained through self-reports at baseline.

Dependent Variables

- Incidence of hypertension based on self-report
- Person-time of follow-up was computed from exposure assessment (12 months post-randomization) until the first occurrence of:
    - hypertension
    - death
    - censoring date - date of receipt of last follow-up questionnaire

Independent Variables

- Nut consumption
- During the 12 month questionnaire, information on selected foods including fish, red meat, ice cream, cheese, chicken or turkey was collected.
- Information on nut consumption was self-reported using a simple abbreviated semi-quantitative food frequency questionnaire at 12 months post-randomization (1983-1985). Participants were asked the following: "Please indicate how often, on average, you have eaten each of the following foods during the past year". "Nuts (small packet or 1 oz)". Possible response categories included "rarely/never", "1-3/month", "1/week", "2-4/week", "5-6/week", "daily" and "2+/day". Subjects were classified into one of the following categories of nut consumption: none, 1-3 per month, 1 per week, 2-6 per week and 7+ per week.

Control Variables

- Gender
- Education

Description of Actual Data Sample:

Initial N: 22,071 subjects

Attrition (final N): 15,966 subjects

Age: 52.3±8.9 years

Ethnicity: Not noted

Other relevant demographics: All subjects were members of the American Medical Association

Anthropometrics:

- No nut consumption - BMI: 24.5±2.8, 12.5% smoked, 69.8% consumed alcohol, 10.4% had hypercholesterolemia, 50.9% were taking aspirin, 2.1% had diabetes, 83.2% exercised and 64.9% consumed breakfast
- Nut consumption 1-3 times/month - BMI: 24.5±2.6, 10.5% smoked, 73.9% consumed alcohol, 9.7% had hypercholesterolemia, 49.4% were taking aspirin, 1.9% had diabetes, 87.8% exercised and 72.0% consumed breakfast
- Nut consumption 1 time/week - BMI: 24.6±2.6, 9.8% smoked, 75.8% consumed alcohol,10.8% had hypercholesterolemia, 49.2% were taking aspirin, 2.0% had diabetes, 89.2% exercised and 75.8% consumed breakfast
- Nut consumption 2-6 times/week - BMI: 24.4±2.5, 10.1% smoked, 75.6% consumed alcohol, 10.6% had hypercholesterolemia, 50.4% were taking aspirin, 2.3% had diabetes, 89.4% exercised, 76.1% consumed breakfast
- Nut consumption ≥7 times/week - BMI: 24.0±2.4, 11.4% smoked, 74.5% consumed alcohol, 10.8% had hypercholesterolemia, 51.5% were taking aspirin, 3.4% had diabetes, 87.7% exercised and 75.8% consumed breakfast.

Location: United States

Summary of Results:

Key Findings

- Consumption of nuts was associated with a higher proportion of current drinkers, multivitamin use, fish, dairy, red meat, and breakfast cereal consumption.
Compared to subjects who did not consume nuts, multivariable adjusted hazard ratios (95% CI) for hypertension were 0.97 (0.91–1.03), 0.98 (0.92–1.05), 0.96 (0.89–1.03), and 0.82 (0.71–0.94) for nut consumption of 1–2 times per month, 1 time/week, 2–6 times/week, and 7 times/week, respectively.
When stratified by the BMI, there was an inverse association between nut consumption and hypertension among lean (BMI< 25 kg/m2) but not overweight/obese subjects. For lean subjects, multivariable adjusted hazard ratios (95% CI) were 1.0 (reference), 0.93 (0.86–1.01), 0.94 (0.86–1.03), 0.87 (0.79–0.96), and 0.77 (0.64–0.93) from the lowest to the highest category of nut consumption, respectively (p for trend 0.0019).
No inverse association was observed between nuts and incident hypertension for BMI ≥ 25 kg/m2 (p for trend 0.39). There was evidence for an interaction between BMI and nut consumption on the risk of hypertension (p for interaction 0.0037). Stratification by smoking did not alter the findings and there was no interaction between smoking status and nut intake on hypertension risk (p for interaction 0.16).

Author Conclusion:

- In this prospective cohort, a lower incidence of hypertension with nut consumption among US male physicians was observed
- The association was mainly observed among lean subjects (BMI<25 kg/m^2) and not in overweight or obese individuals

- In conclusion, the data suggest that frequent consumption of nuts is associated with a lower risk of incident hypertension in US male physicians and such relation appears to be limited to lean individuals.

Reviewer Comments:

- *Participants were male physicians who may have different behaviors or lifestyle habits than the general population, thereby limiting the generalizability of the findings*
- *Nut consumption was assessed only once (12 months post-randomization) and since subjects may have changed their dietary habits, changes were not able to be accounted for in analyses*
- *Adjustments for total energy intake and other nutrients consumed by subjects were unable to be made because a simple questionnaire was used to assess nut consumption*
- *Incidence of hypertension based on self-report*
- *Data was not available on types of nuts consumed; their preparation including salted, spiced, roasted or raw nuts to examine the influence of types of nuts or preparation method on the risk of hypertension*
- *It was possible that some of the subjects were misclassified due to inaccurate recall on nut intake*
- *In the absence of random allocation of nuts, unmeasured or residual confounding could be a possible explanation for observed findings.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes

2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	Yes
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	Yes
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	N/A

5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	N/A
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	Yes
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	???
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes

7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes